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# Speech Pathology Student Perspectives on Virtual Reality to Learn a Clinical Skill

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# Speech Pathology Student Perspectives on Virtual Reality to Learn a Clinical Skill

## Abstract

Evidence supports the use of simulation in educating speech pathology (SP) students, however most of the research has centered on low fidelity techniques as opposed to high fidelity and immersive technologies like virtual reality (VR). Whilst there has been research on the use of VR to teach clinical skills to students in other health disciplines (e.g., dentistry, nursing), use of VR in SP has focused mainly on its use in client intervention. There is an opportunity to use VR to teach clinical skills to SP students, particularly in response to barriers to clinical placement opportunities like the COVID 19 pandemic. Aim/s: The aim of this qualitative study was to explore students' perceptions on the use of VR to learn a clinical skill: administration of an oral musculature assessment (OMA). Second year SP students received VR training on OMAs (VR-OMA) at the start of their first pediatric clinical placement. Students completed a brief, open-ended survey regarding their experiences and perceived impact of the VR tool. Data from 55 surveys were retrospectively analyzed using a thematic approach. Results: Survey responses highlighted that the VR-OMA training created a positive learning experience. Five themes were generated: the technology, the teaching and learning strategies, the outcomes, the experience, and a good alternative. Speech pathology students valued the inclusion of the VR-OMA training in their learning and highlighted many advantages to the use of this technology when learning a clinical skill.

## Keywords

Simulation, undergraduate student education, speech pathology, virtual reality, oral musculature assessment

## Cover Page Footnote

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Simulation is the technique of replicating real world experiences, where opportunities to observe, interact, and participate in life-like scenarios are created (Alinier, 2007). When used in education, simulation creates unique learning opportunities, where through safe, scaffolded experiences, students can translate theory into practice (Gaba, 2004). Using simulation, students can be immersed in tasks and activities as if it were the real world, interacting within the replicated system to achieve a range of objectives. In health-related fields, simulation has been adopted for training pre-professionals and professionals alike. It can be applied to initiate skill development or to enhance and refine advanced practice skill sets (Gaba, 2004). Simulation has been embraced by health education for its ability to support clinical skill development in the absence of patient interaction (Alinier, 2007).

Simulated learning experiences allow health students to learn new information, build their clinical skills, shape their procedural abilities, and acquire new perspectives without risk to patient safety (Gaba, 2004; Theodoros et al., 2010). These experiences can be designed to tailor the amount of guidance and feedback, with educators adjusting the level of scaffolding to direct the student to the target behavior or learning objective. The experience can then be repeated, giving learners the ability to apply their new knowledge to shape clinical behaviors. Through simulated learning opportunities, students can be supported to translate theoretical knowledge into practical skills, reducing the likelihood of novice errors as they enter real client interactions in placements and professional settings (Dawe et al., 2014). In the process of building clinical skillsets, students start developing a sense of their own clinical skills, (Robinson et al., 2020; Rose et al., 2017; Shorland et al., 2013). Simulation helps students build their confidence. This is important because confident students are more able to center their focus on the client, rather than fixating on their own behaviors, enabling more advanced professional competencies (Brumfitt & Freeman, 2007).

Simulated learning experiences can be described by their level of fidelity: the extent to which they can imitate the original and the degree of believability of the experience (Maran & Glavin, 2003). Low-fidelity simulation techniques, including student role plays and the use of mannequins, only partially replicate the experience or behavior of real-life scenarios (Alinier, 2007). More intermediate-fidelity simulation techniques include use of patient actors and simulated environments, where a space is physically designed to appear like the setting it is attempting to simulate (Alinier, 2007). High-fidelity experiences include technologies such as mixed reality and virtual reality (VR) applications. Mixed-reality simulation, also referred to as non-immersive virtual reality, uses computer software that allows users to interact with an on-screen virtual world. Virtual reality uses software and hardware, such as VR headsets and goggles, to immerse users in virtual worlds. Each simulation type offers a unique experience to the user and offers its own set of advantages, whether pragmatic or experiential. Research into the implementation of simulation techniques has helped build an understanding of how they each affect learning outcomes.

**Virtual Reality and Health Education**

The VR user experience is both immersive and interactive, creating unique learning experiences for students. Sensory information is used to create a sense of presence in the virtual world; visual, acoustic, and haptic features remove the user from their reality and immerse them in a three-dimensional (3D) virtual reality (Smith, 2019). The VR interface enables users to interact with this world. Through physical movement, users can control perspective, make selections, and manipulate objects (Kyaw et al, 2019). Educators can use this immersion and interaction to create experiences that enable students to actively engage in learning as if they were in a clinical environment.

Research has examined how the use of VR shapes performance on episodic memory (Smith, 2019). VR users were more able to accurately recognize objects, scenes, and sequences displayed in comparison with those who had the same experience on a two-dimensional screen (Smith, 2019). The evidence for VR application in health and medical training is building, and its effect on learning outcomes related to anatomy, physiology, generic professional skillsets, and technical procedural competencies is continuing to be examined (Bakhos et al., 2020; Davis, 2015; Englund et al., 2017; Khan et al., 2018; Larsen et al., 2012; Lohre et al., 2020; Sabus et al., 2011; Shorey et al., 2020; Shorey & Ng, 2021; Willaert et al., 2012).

The majority of the evidence for the application of VR in health education has come from training of medical students and professionals. It is considered particularly advantageous for training in surgical procedures. Research has examined the use of VR in medical educational settings and as a part of pre-operative rehearsal (Willaert et al., 2012). One blinded, randomized controlled trial examined the effect of VR on training orthopedic residents for a complex surgical procedure. It found that residents who had received the VR training performed better on instrument handling measures and performed the procedure more efficiently than those who received instruction via a technical journal article (Lohre et al., 2020). There was no significant difference in results of knowledge tests between the experiment or control group. This study highlighted the technical and non-technical transfer of surgical skills through the use of VR technology.

A systematic review of research into the use of VR to train laparoscopic procedures found that students who received training via VR had better procedural skillsets than those who received traditional training or no training (Larsen et al., 2012). This research strengthens the argument for the use of VR for technical skillset training. Research in nursing and gastrointestinal endoscopy found similar evidence to support implementation of VR into pre-professional training protocols, but the body of evidence lacks ability to recommend its use above other training protocols (Khan et al., 2018; Shorey and Ng, 2021).

The efficacy of VR in allied health education has been researched and described in pharmacy (Englund et al., 2017), dietetics (Davis, 2015), audiology (Bakhos et al., 2020), physiotherapy (Sabus et al., 2011), and occupational therapy (Sabus et al., 2011) student training. Sabus and colleagues (2011) applied VR to teach physiotherapy and occupational therapy students to complete collaborative home evaluations. Professionals rarely have the opportunity to see their home modification recommendations after they have been completed. However, with VR software, students were able to see recommended modifications implemented. This provided them the opportunity to evaluate their work. The study found that students made more specific and contextually appropriate recommendations after receiving the VR training. A randomized controlled trial was also conducted to analyze the use of VR to teach technical procedures for audiology students (Bakhos et al., 2020). Students' performance on knowledge tests was used the outcome measure. The study found that the students who had used VR performed significantly better than the control group, who received traditional training.

Virtual reality has also been used by speech-language pathologists in the clinical management of clients with communication disorders. A review by Bryant et al. (2020) found limited evidence was found for the implementation of VR in therapy. One study examined the perspective of children with autism spectrum disorder who received VR training to target social communication skills (Halabi et al., 2017). The children preferred the use of VR compared to non-immersive technologies. This work reflects a growing understanding of the potential application of VR across the speech-language pathology profession.

### Speech Pathology Skills Training through Simulation

High fidelity, mixed-reality simulators have been used to train generic professional skills for speech pathology undergraduate students. Generic professional skills reflect the standards of behavior that are not unique to the speech pathology profession but are still critical for successful practice, including communication and interpersonal skills, collaboration, and ethical practice (Speech Pathology Australia [SPA], 2020). Robinson et al. (2020) and Towson et al. (2018) analyzed the effect of a mixed-reality simulation program to target students' communication and interpersonal skills and abilities. Robinson (2020) examined the use of mixed reality to improve communication and interpersonal skills in client interactions. Findings indicated a significant increase in educator ratings of clinical interpersonal and communication skills from the initial attempt at the experience to the second attempt. Towson et al. (2018) examined the use of mixed-reality simulations to communicate with stakeholders, including other professionals. All students demonstrated significant improvement in communication skills from pre to post test. This study's findings were limited by a small participant sample, with only three speech pathology student participants. A randomized controlled trial by Towson et al. (2021) similarly examined the use of simulation to train interprofessional communication skills to speech pathology students. The outcomes of students who received training via mixed-reality simulator was compared to those of students who completed role plays. Both groups demonstrated significant improvement in interprofessional communication skills, with no difference between the two groups. These studies demonstrate the potential for high-fidelity simulations to shape communication skills in undergraduate speech pathology students.

Mixed-reality simulation has also been used to teach speech pathology students technical assessment and treatment skills. A study by Carter (2019) compared the effect of mixed-reality simulated training to standard teaching protocols for clinical reasoning in the assessment and treatment of pediatric communication disorders. The study found that students who received mixed reality simulation training performed significantly better in their ability to implement key aspects of assessment and treatment than those who received paper-based case study training. This study was unique in that it not only examined the impact of mixed reality on clinical reasoning skills when assessing and treating pediatric language disorders, it also compared the clinical reasoning of students when applied to caseloads not included in the training. They found that students who participated in mixed-reality simulation demonstrated better clinical reasoning skills than the control group when provided cases from other clinical areas, including dysphagia, aphasia, and voice. This study demonstrated the capacity of high-fidelity simulation to support clinical skill development in speech pathology students.

Through advancements in digital technology, simulation tools are becoming increasingly more accessible and affordable for educators (Ghanbarzadeh et al., 2014). Where the inclusion of high-fidelity techniques is becoming increasingly viable, research is required to understand how these technologies could improve learning experiences and shape outcomes for speech pathology students. Other health professions have shown VR can be successfully implemented as a teaching tool. While there is evidence for high-fidelity simulations in teaching undergraduate students, there is no evidence to support the implementation of VR for the purpose of speech pathology education.

This study seeks to gain the perspectives of speech pathology students on the use of a VR application for learning a key clinical skill: the delivery of a Virtual Reality - Oral Musculature Assessment (VR-OMA). Oral musculature assessments (OMAs) are routine components of pediatric speech assessments. They are used to assess the structure and function of the client's oral mechanism, and this information is used to assist diagnosis (Bankson et al., 2017). Through analysis of student feedback, this study aims to evaluate student perspectives on the use of VR to train a clinical skill: administering an oral musculature assessment.

## Method

**Ethical Clearance.** Ethical approval was received in July of 2021 by the University of Newcastle's Human Research Ethics Committee (approval identification number H-2021-0225).

**Implementation of VR-OMA.** In developing the VR-OMA application at the University of Newcastle, two children were filmed participating in an OMA in a speech pathology clinic. Filming was from the perspective of the clinician, and narration provided an explanation of task items. The 3D film was then used to make the immersive application.

The VR-OMA application was implemented during a non-compulsory tutorial for a second-year clinical practicum course at the University of Newcastle. Two lecturers were present for the tutorial to introduce VR-OMA and provide support for its use. At the start of the tutorial, students were provided a single-page handout as an introduction to VR-OMA. The document included an orientation to the features of the hardware, health and safety considerations, and instructions on the use of the application. Additionally, the lecturers provided verbal instructions at the start of the tutorial. Students were provided support where necessary in adjusting the headsets and entering the VR-OMA application. The narration and application text were in English, with no other language options available.

The hardware delivery system Oculus Quest 1 (Oculus VR, 2019) free standing (un-tethered) headset was utilized to provide the 3D, virtual reality OMA experience. On entering the main menu, students were given two client options to select from: Hendrix (pseudonym; 4 years of age) and Ciara (pseudonym; 6 years of age). They were asked to select Ciara first for pedagogical reasons. The students then navigated through VR-OMA by selecting individual task items, which played out in a video sequence with accompanying narration. The task items available for selection are presented in Table 1. Students had control of the sequence in which task items were played. They could navigate through at their own pace and could choose to repeat a task. Once they had explored the task options for one client, they were then required to select the second client, where they had the same control of task selection and sequence. The students completed the OMA with both clients in the order of their choosing.

**Study Design.** This study used a retrospective qualitative design. The data being analyzed came from existing surveys collected at time of VR-OMA implementation.

**Table 1**

*VR-OMA Task Items*

| VR-OMA Categories | VR-OMA Task Items |
|---|---|
| Mouth/Cheeks | Open/Close<br>Puff cheeks with resistance |
| Lips | Pursed/Spread/Combined/Repeated<br>Labial frenulum |
| Teeth | Together front<br>Clenched back |
| Tongue | Out/In/Combined/Repeated<br>Top lip/Nose/Bottom Lip/Chin<br>Behind top teeth/behind bottom teeth<br>Corners of lips/Each corner repeated<br>Pushing cheeks out with resistance<br>Circulating external/Clearing upper internal<br>Clearing lower internal |
| Internal oral cavity | Appearance<br>Sustained 'ah'/Repeated 'ah' |
| Diadochokinetic | 'Puh'/'Tuh'/'Kuh'<br>'Puh-tuh-kuh' |

**Participants.** Fifty-five second-year undergraduate speech pathology students from the University of Newcastle were conveniently sampled. Students were enrolled in their first pediatric clinical placement course, which occurs in the second year of their four-year program. This course involved a 20-week practicum (whereby students attended their site one day per week), and an accompanying tutorial on-campus on a different day from their placement. Whilst tutorial attendance is recommended, mandatory attendance was not enforced. The VR experience described above was delivered as one of the tutorials for this course. Student participants were enrolled across three semesters from 2020 to 2021. As the surveys were designed to be completely anonymous, demographic details (e.g., age, computer literacy levels, experience with OMAs, and level of familiarity with VR and/or gaming) was not recorded. There were 99 students in total enrolled in the placement course. However, only 77 were able to complete the tutorial due to social distancing measures implemented to control the disease caused by the novel coronavirus SARS-CoV2 (COVID-19). Of these, 55 students completed surveys (response rate = 71%).

**Data Collection.** Surveys consisting of open-ended questions were provided to the students. The survey included two questions: "Tell us one thing you liked about the VR-OMA experience?" and "What impact do you think the VR-OMA tool will have on your clinical skills during your SPTH2080 placement?" Participation in the survey was voluntary, and students were able to leave completed surveys by the door on their way out of the tutorial if they chose to complete them.

**Data Analysis.** Thematic analysis was selected as an approach to systematically analyze the data, using steps described by Braun and Clarke (2006) to guide the iterative process of analysis:

1. Written responses were recorded into a Word document.
2. Written responses were imported into NVivo 12 for coding (QSR International, 2020).
3. The data were coded for units of meaning, and codes were then collated into initial themes.
4. Data were analyzed at the semantic level; codes were developed by interpreting the words and language used explicitly by students.
5. The codes within each theme were reviewed amongst the full research team to ensure coded extracts were cohesive.
6. Codes and themes were reviewed inductively, with an attempt to minimize the impact of existing knowledge of the subject area on the process of analysis, being aware of how knowledge of the theoretical advantages of VR influenced identification of themes.
7. After the continued process of review and analysis, global themes and subthemes were defined and named.

## Results

Analysis of survey responses generated five key themes related to students' perspectives of the VR-OMA training. The five key themes and the codes and sub-themes that underpin them are highlighted in Table 2. Verbatim quotes have been included to illustrate themes and subthemes.

**The Technology.** This theme was generated from a pattern of perspectives centering on the use of technology in the VR-OMA training. Students reflected on the nature and functionality of the technology that they liked and disliked, reacting to the use of the technology in their learning. Most students identified liking the technology and its interactive functionality:

> *I was really impressed by the technology and how real it felt; It was like you were in the room with them, and it made every step so much more visual.*

One student commented they expected the technology to be more interactive than they felt it was:

> *I originally thought that it would be really interactive/hands on i.e. looking close up inside the mouth, "touching" the cheeks ourselves/ use tongue depressors etc.*

One student identified having an adverse reaction to the technology:

> *Hopefully we won't need to use it again because it made me feel ill.*

**The Teaching and Learning Strategies.** A theme was identified surrounding students' perspectives of the teaching and learning strategies embedded in the VR-OMA training. They described these strategies, highlighting what they valued and why they valued them. Students identified different strategies that they liked, including use of repetition, modeling and observation, guidance, case-based teaching, and active learning. One student described the value they placed on strategies, such as observation and case-based learning:

> *It's the best explanation of an OMA I've had. Being able to see it done firsthand really put me in the moment. I also thought that 'doing' 2 OMAs of different aged clients to display the challenges which may apply ie the boy was rather restless.*

A few students made recommendations for how these techniques could be extended in future VR-OMA experiences. They suggested that the use of typical client cases to teach clinical skills could be enhanced by the inclusion of an atypical case as a point of comparison:

> *They were 'normal' display. Perhaps would have been beneficial if there were examples of some abnormalities to see.*


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**Table 2**

*Themes, Subthemes and Quotes*

| Theme | Subthemes | Quotes |
|---|---|---|
| The technology | New | *"I have never used anything like it before"* |
| | Interactive | *"[I like that it was] interactive/[you] can move at your own pace"* |
| | I felt ill | *"Hopefully we won't need to use it again because it made me feel ill"* |
| | Easy to use | *"[It] was easy to use and understand"* |
| | Presence | *"Was much more engaging feeling like I was actually there"* |
| | Fidelity | *"I enjoyed the experience as it exactly mimicked what would happen in a clinic"* |
| The teaching and learning strategies | Repetition | *"[I liked the] ability to rewatch, repeat to familiarize with steps to OMA"* |
| | Modelling and observation | *"It felt like I was able to fully observe what was an actual OMA assessment would look like from the clinician point of view"* |
| | Guided experience | *"[I liked that it] gave a step by step run through with additional info"* |
| | Case based | *"I enjoyed being able to see how the children acted throughout the OMA to give us an idea of what to expect"* |
| | Active learning | *"The experience of working with a child through the clinician's eyes, acting as both an outside observer and in parts, an active participant"* |
| The outcomes | Transition to practice | *"I felt a lot more prepared for placement"* |
| | Skill development | *"I think the VR will have a positive impact on my skills as it allows me to be familiarized with the operation of OMA in an interactive way"* |
| | Knowledge | *"I am more familiar with the process of an OMA assessment and know what to look out for when I conduct one myself"* |
| The experience | Interesting | *"I think [I had] greater absorption of knowledge since it was so interesting"* |
| | Enjoyment | *"It was fun"* |
| | Engaging | *"It was a lot more engaging than a video"* |
| A good alternative | | *"It was a really good alternative to not being able to conduct OMAs this semester on placement due to NSW health guidelines."* |

**The Outcomes.** A theme was generated centering on students' perspectives on the effect the VR-OMA training will have on them, their learning, and their clinical skills. Some students commented that the experience will affect their transition to implementing an OMA with a real client. Further, some noted that the training has shifted the way they think and feel about doing an OMA. Some students described increased confidence:

> *As I will be more confident, I will have more authority over the client, which will be especially useful with a distracted, naughty child.*

Other students described a change in perspective towards doing an OMA on placements:

> *[It] gives me a good idea of what to expect before placement, therefore I won't be as overwhelmed when presented with an OMA to conduct on placement.*

Students considered the outcomes of the training on their skill development and knowledge of OMAs. One student commented:

> *I think it will have a positive constructive effect on my clinical skills in enriching my understanding of OMA assessment and how they are implemented.*

A few students described how the learning through the VR-OMA training integrated with other learning opportunities, as one student commented:

> *Tying in the procedure of the OMA and the knowledge from HUBS1107 [Human Biomedical Sciences] provides a whole picture of what the anatomy tells us.*

**The Experience.** This theme was generated from students' descriptions of their experience of the VR-OMA training, how they felt during the experience, and what they thought of the experience more broadly. Some students described the experience as interesting:

> *I think [I had] greater absorption of knowledge since it was so interesting.*

Other students described enjoying the experience, and others described it as engaging. One student made the following comparison of the VR-OMA training to traditional learning techniques:

> *It was a fun engaging experience, rather than just sitting and listening to a presentation.*

**A Good Alternative.** A final theme was generated from the utility of the VR-OMA training in lieu of client contact. Many students described liking the VR-OMA training as an alternative, as they were not able to do OMAs on their clinical placements. Some students cited the COVID-19 pandemic specifically:

> *As we will most likely not be able to complete an OMA due to covid restrictions it gave us an opportunity to observe what an OMA assessment would actually look like in a pediatric setting.*

Two students considered the VR-OMA training as a good alternative, as it removed client discomfort:

> *Having a bunch of students watch a supervisor give an OMA could be distracting and uncomfortable for a child, the VR gives the first-person perspective of a comfortable child and gives the relevant information need for specific assessment.*

## Discussion

The aim of this study was to identify student perspectives on the use of virtual reality technology to learn a fundamental clinical skill. This study found students had an overall positive reaction to the VR-OMA training, with responses reflecting students' intrinsic and extrinsic value for the training experience. Intrinsic value, the overall enjoyment of a learning activity, alongside extrinsic value, the perceived benefit of the task, are core components of motivation to learn (Wigfield & Eccles, 2000). Wigfield and Eccles' (2000) Expectancy Value Theory describes how intrinsic and extrinsic value shapes students' motivation to achieve and affects their achievement-centered behaviors and choices. Pintrich and DeGroot (1993) found that intrinsic value positively correlated to students' performance and self-regulation: their ability to apply metacognitive strategies to engage in learning. Given the critical role intrinsic and extrinsic value plays for shaping student motivation, students' perspectives in this study illustrate the pedagogical value for the VR-OMA training. Sub-themes centering on "engagement", "enjoyment", and "interesting" demonstrated students' overall satisfaction with the experience. Aspects of the technology, functionality, and the teaching and learning techniques that were incorporated were deemed positive components of the VR-OMA training. Studies that have examined the perspectives of pharmacy, nursing, and medicine students have similarly found students report a general satisfaction with VR for learning (Englund et al., 2017; Lohre et al., 2020; Pickering et al, 2018).

The most pervasive theme in the data focused on student outcomes and the utility of the experience, including feeling more ready (and with improved ability) to implement an OMA on a real client and having more knowledge of OMAs in general. Self-perceived outcomes from the VR-OMA training have been similarly reported in other studies that have examined student perspectives on the incorporation of VR into health training. Pharmacy, dentistry, nursing, medical, and anatomy students consistently reported a perceived benefit to learning via VR, whether for developing clinical skills or technical knowledge (Codd & Choudhary, 2011; Englund et al., 2017; Lohre et al., 2020; Pickering et al., 2018; Zafar et al., 2021).

Another key theme centred around the functionality of the VR technology. Students described the VR-OMA training as easy to use in general. This is in contrast to findings from a study on pharmacy students' perspectives on the use of VR as an instructional tool, where students reported technical difficulties as a barrier to learning (Englund et al., 2017). Speech pathology students similarly described having difficulties with computer-based simulation software (Clinard & Dudding, 2019; Smyers, 2019). Briefing students to the task and the technology are components of best practice in relation to simulation training, the absence of which can create confusion and frustrations that detract from the learning experience (Lioce et al., 2015). The use of orientation documents and the presence of two lecturers to facilitate the VR-OMA training experience may therefore have reduced the technological barriers for the students involved in this training. It is possible that demographic factors such as age of students, their computer literacy, and previous exposure to VR and/or gaming in general may have shaped the perspective of these students when engaging with VR-OMA training. Whilst this demographic data was not collected in the current study, future research could consider these factors and how they may correlate with experiences with high fidelity teaching tools such as VR.

This study provided insight into the teaching and learning strategies that students valued. The strategies identified by students reflect known pedagogical techniques for higher education. Students reported that the ability to repeat the experience was valuable. Practice and repetition are evidence-based techniques for building technical skills; skill acquisition and retention is enhanced through repeated practice (Moulton et al., 2006). Students liked the use of modeling and observation. These are core training techniques in clinical health education; with students on clinical placement observe the clinical role model and attempt to internalize the behaviors they observe so that they can reproduce the behaviors themselves (Horsburgh & Ippolito, 2018). The concept that learning occurs through observation of modeled behaviors is a core component of Bandura's theory of social learning (Bandura, 1992).

Students also liked case-based learning, including the use of real-life cases. Through use of cases based on real-life children as opposed to fictional characters, the functional fidelity of the activity is enhanced, increasing the relevance of the task to real-life scenarios (Hamstra et al., 2014). According to the principles of case-based learning, use of cases promotes active learning. Students are engaged in processes such as comparison, identification of challenges and solutions, and synthesis of existing knowledge with new knowledge (Carter, 2019). Students also provided constructive feedback on the use of case-based learning. Some students indicated that they would like to see an expansion of cases to include atypical presentations. This feedback echoes the identified benefits of simulation training, which has been used to expose students to rare client cases (MacBean et al., 2013; Theodorous, 2010).

Students in this study described being active participants in their learning. Pedagogical theory supports use of active learning. Students who are involved and have control of their learning have greater satisfaction with learning processes and better learning outcomes than if they receive traditional lecture-based learning (Affoo et al., 2020; Bonwell & Eison, 1991). While many in this study described use of active learning processes, one student described the experience as not meeting their expectations in terms of the degree of interactivity. As a result, they stated that they felt passive in the experience. This perspective highlights the value students place on active learning and that when implanting a VR training technique such as the one described in this study, educators should consider ways to maximize student active involvement in learning processes.

One student in the cohort reported that VR-OMA made them feel ill. This reaction to immersive VR is common. It is termed "simulator sickness" and is believed to be caused by conflicting sensory input, where the vestibular system is indicating the body is stationary but the visual detail in the virtual world indicates the person is in motion (Smith, 2019). While this reaction was uncommon for the current participants, this insight is important for educators who want to implement VR training in the future. When orienting students to VR hardware, educators should ensure that students be prepared for the possibility of feeling unwell and advised what to do if this occurs.

The utility of the training was framed as a good alternative in the absence of real client interactions. While some identified this as benefit, as it provided them an opportunity to learn without causing any client discomfort, many considered it in light of barriers to clinical placement opportunities. Some students referenced the COVID-19 pandemic directly as limiting their opportunity to perform an OMA due to health restrictions that limited their proximity to clients.

Educators and workplaces are seeking innovative solutions to challenges with providing placement opportunities more broadly. In Australia, the growing workforce has seen a complimentary increase in the number of universities offering speech pathology programs and the number of speech pathology student enrollments (Theodorous et al, 2010). As the body of speech pathology students grow, so does the demand for clinical placement opportunities. Both the American Speech-Language Hearing Association (ASHA) and Speech Pathology Australia (SPA) have acknowledged the value of simulated learning experiences for student training. In the United States, experience gained through simulated learning can count for up to 20% of required clinical hours needed for certification (American Speech, Language and Hearing Association, n.d.). In Australia, where accreditation is competency-based, observation of students in simulated scenarios is classed as indirect evidence of competency. It supplements direct evidence obtained through client contact (Theodorous et al., 2010). In a report completed by Health Workforce Australia, representatives from SPA (Theodorous et al., 2010), representatives from speech pathology faculties across Australian universities and other key stakeholders were consulted on the inclusion of simulated learning environments in speech pathology clinical education. All respondents agreed that integration of simulated learning techniques in teaching foundational clinical skills would enhance the quality of student's clinical placements (Theodorous et al., 2010). The current results highlight that incorporation of the VR-OMA tool into the curriculum can support students in learning a core clinical skill, particularly when opportunities on placement are limited.

**Limitations and Future Directions.** Participants in this study were undergraduate speech pathology students from a single university. This limits the generalizability of the study's findings; they cannot be seen as reflective of all students' perspectives on the use of VR to teach a clinical skill nationally or internationally. No student demographic data was collected, such as age, computer literacy levels, English as second language status, or familiarity with VR and/or gaming. These factors may influence student perspectives on their use of the VR-OMA application and create bias in the data. Inclusion of demographic data in future research will help explain how these factors impact student perspective on the integration of VR technology in teaching and learning. The open-response surveys included two questions only. The surveys were kept intentionally brief and qualitative. Future research could utilize other published surveys to investigate student perceptions on the use of VR technology, including both quantitative and qualitative data for a more detailed analysis of the use of the VR-OMA application to train a clinical skill.

Finally, the students were asked to engage with the two child cases within VR-OMA in a certain order for pedagogical purposes. It is uncertain if this order may have impacted student perceptions of this tool. That would be an interesting construct to explore in future research.

## Conclusion

This is the first study to analyze perspectives of speech pathology students on the use of immersive virtual reality to teach a fundamental clinical skill. Its findings contribute to the literature by providing students' perspectives on aspects of the training design, including the technology, strategies, their experience, how they perceived the training contributed to their learning, and the value of the training overall. Overall, students' perspectives reflected the value of the VR-OMA experience. Findings from student feedback support the integration of immersive VR for training technical skills into curriculum in preparation for clinical placements, as well as in circumstances where clinical opportunities are limited. Future directions for research should attempt to deepen the evaluation of VR-OMA, such as through use of mixed methods research designs to analyze perspectives or measure changes in knowledge or clinical skillset. The study has identified opportunities to develop the VR-OMA application through the inclusion of a broader range of cases in the application.

## Author Declaration

The authors have no conflicts of interest to be disclosed.

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